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SOYBEAN PRODUCTION IN OHIO

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SOYBEAN PRODUCTION IN OHIO

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Acreage—The soybean has become a major field crop in Ohio. The acreage harvested for beans increased from only 20,000 acres in 1924 to 1,499,000 acres in 1960 and 2,105,000 acres in 1966. The increase in soybean acreage has come both from additional acreage in the "soybean counties" and from counties where soybeans are a new crop. Soybeans account for 10 percent of the total farm cash receipts in the state, exceeding corn by 1 percent and wheat by 2 percent.

The distribution of soybean acreage by counties in Ohio for 1965 is given in Figure 1. The high producing soybean counties are also high producing corn counties as shown in Figures 2 and 3. There is definite competition between corn and soybeans for acreage in Ohio.

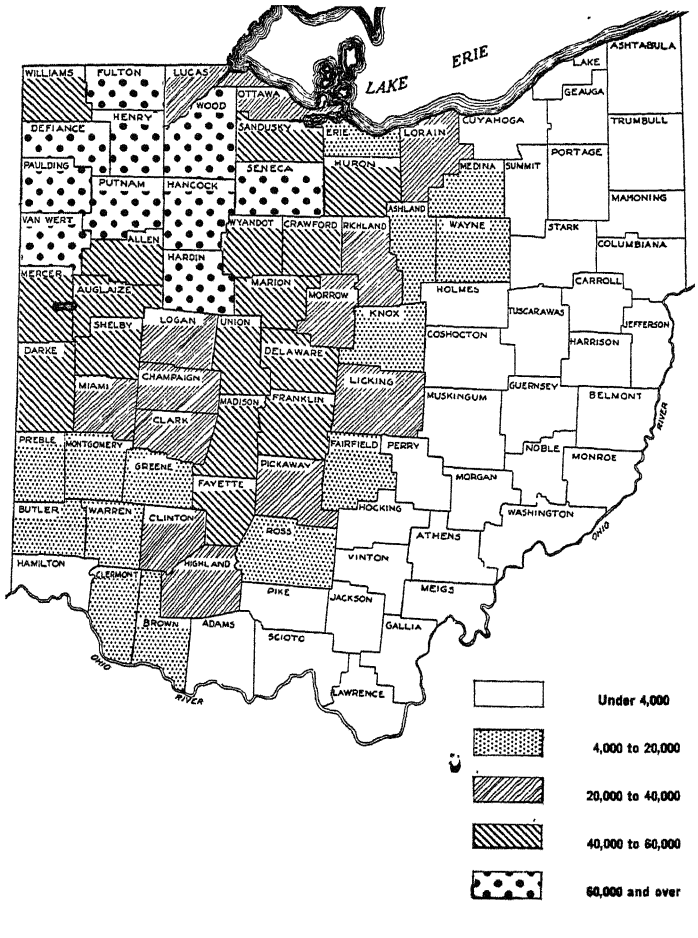

FIG. 1—Acres of Soybeans Harvested for Grain in 1965

Source of Annual Recommendations—The first tests of soybean performance were made by state agricultural experiment stations in 1889. Since then, vast amounts of information have been obtained relative to soybean production and management. This bulletin deals primarily with the principles and methodology of efficient soybean production. Current annual recommendations may be found in the *Ohio Agronomy Guide*, Extension Bulletin 472.

The *Guide* should be used in conjunction with this bulletin. It provides information on currently recommended crop varieties, herbicides for weed control, and fertilizer recommendations.

The *Ohio Agronomy Guide*, prepared by members of the agronomy department, is published by the Cooperative Extension Service of The Ohio State University. Copies may be obtained from any county Extension Service office or by writing directly to the Agronomy Extension Office, 1885 Neil Avenue, Columbus, Ohio 43210.

Adaptation—Soybeans perform best on fertile, well drained soils. They can be grown under a wide variety of soil conditions and, in most cases, produce a more favorable return than most other farm crops. They are resistant to wide temperature fluctuations and varied soil moisture conditions.

Uses—Soybeans are grown chiefly for the seed or beans which are processed to produce oil and meal. About 95 percent of the high protein meal is fed to livestock and poultry. Most of the oil is used for human consumption in the form of margarine, shortening, and salad oils.

Selection of Variety

For efficient soybean production, the variety or varieties selected must be suitable for the conditions under which they are to be produced. Many varieties of soybeans are recommended for production in Ohio. The growth characteristics and disease resistance of these varieties vary considerably. All of the recommended varieties are potentially high yielding and all are satisfactory in oil and protein content. The characteristics of the recommended varieties are listed in the *Ohio Agronomy Guide*. Several varietal characteristics that should be considered in the selection of variety or varieties to be grown include:

(a) **Maturity**—Of the varieties recommended for production in Ohio, the average number of days to maturity ranges from 110 to 138. Full-season varieties usually produce higher yields than earlier

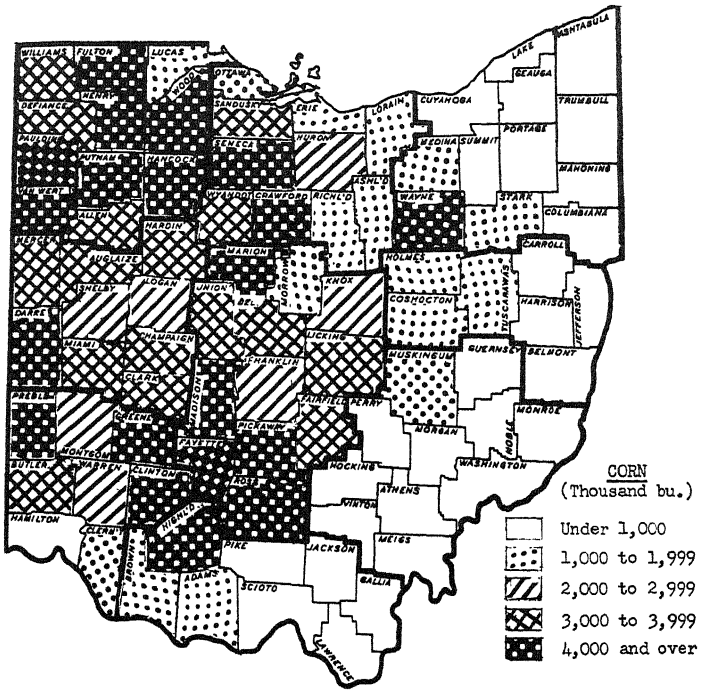

FIG. 2—Distribution of Corn Production by Counties, 1965

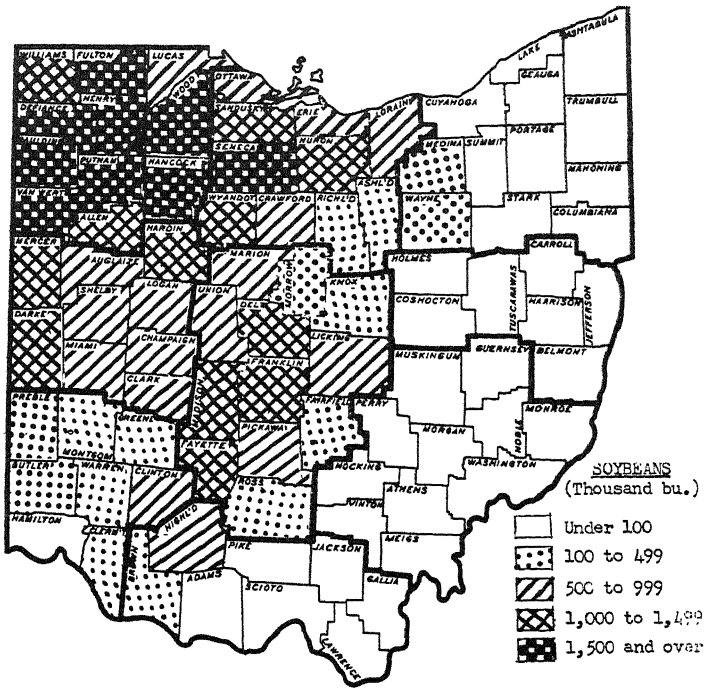

FIG. 3—Distribution of Soybean Production by Counties, 1965

maturing varieties. The length of the growing season should be taken into consideration in the selection of a variety. Some conditions, such as seeding wheat following soybeans, may dictate the selection of a variety that will mature in less than the full growing season.

For maximum harvesting efficiency, soybeans should be harvested as soon as the seed reaches 14 percent moisture. Earlier harvesting is recommended only when the seed can be artificially dried. Soybeans mature enough to be harvested should be combined within five or six days. If the soybean acreage for a particular farming unit is greater than that which can be combine harvested in a period of five or six days with equipment available, two or more varieties differing in maturity should be planted.

(b) **Lodging**—Although all recommended varieties are sufficiently resistant to lodging to permit satisfactory harvesting under normal growing conditions, there are definite differences among varieties. If the available nitrogen is so high that lodging is a serious problem, the variety or varieties with the best standing ability should be grown.

Planting at a higher than recommended seeding rate will greatly increase the amount of lodging. Even varieties that have top rating for resistance to lodging will lodge badly if planted at an excessively high rate.

Weeds also will cause increased lodging.

(c) **Disease**—Currently, Phytophthora root rot is the most serious disease of soybeans in Ohio. Although this disease has been found in all counties producing soybeans, it is generally of an economic importance only in the heavy, poorly drained soils of northwestern Ohio. Most of the recommended soybean varieties are resistant to this disease; however, some are not. Be certain to take this into consideration in the selection of the variety or varieties to be grown. The recommended varieties differ in their reaction to several other diseases. Be certain to consider these disease reactions in the selection of varieties.

Top Quality Seed

Investment in seed is usually about 5 to 10 percent of the total cost of production. High quality seed means genetic purity for variety, high germination, freedom from inert material, disease or insect damage, mechanical damage, and weed seeds, and of uniform size and shape. **Certified seed** produced under the rules, regulations, and supservision of a seed improvement association is one class of seed that can be depended on to possess high quality. Once the variety or varieties have been selected, the best possible lot of seed of that variety should be secured.

The Ohio Seed Law specifies that all seed sold in Ohio must carry an analysis tag which describes the seed. A careful study of these tags is highly important. The state law permits the sale of low quality seed if the analysis tag is labeled properly; for example, a lot of seed germinating only 10 percent or less can be legally sold in Ohio as seed if the analysis tag so specifies. Therefore, it is not enough to buy a bag of seed with an analysis tag attached. You must read this tag.

Soybeans can be more easily damaged during harvest, handling, and storage than any other major farm crop grown in Ohio. Germination may decrease rapidly with age, and that old seed which germinates may not produce healthy and vigorous seedlings. For these reasons, a germination test should be made on any lot of soybeans before planting.

It is profitable to purchase **certified seed** each year for every acre of soybeans to be planted. The difference in investment between top quality certified seed and low quality seed will perhaps be only 2 to 3 percent of the cost of production. This is relatively inexpensive insurance to give your soybean crop a good start and obtain increased yields.

Commercially produced soybeans should not be retained for seed unless, with proper processing, high quality seed can be recovered. Since germination is such an unstable quality of soybeans, a germination test should be made as close to planting time as is feasible. Many samples of "seed" collected from top farmers in drill-box surveys have germinated less than 40 percent. Few can afford to plant such "seed."

The State Seed Testing Laboratory at Reynoldsburg, Ohio will run germination tests for farmers of Ohio. During certain seasons of the year, these will be run free of charge, at other times, a small charge will be made. A letter to the Laboratory will supply you with this information.

High quality seed, properly planted, will assure rapid germination and emergence, thus producing a plant population that will compete with weeds and produce a top quality crop.

Remember—*"Top quality seed does not cost, it pays."*

Seed Treatment

Seed treatment with a fungicide is not generally recommended with high germination (80 percent or better) seed. The use of chemical seed protectants such as Spergon, Arasan, or Captan have not generally resulted in increased yields. However, stands may be increased when: (a) seed is not of the highest quality, (b) seed has less than 80 percent germination, and (c) when weather conditions at planting time are not favorable for rapid germination. When soybeans are planted on new land, it is best not to treat the seed because of its adverse effect on bacterial innoculants.

Although seed treatment seldom results in increased seed yields, the improved stands resulting from seed treatment may aid in giving soybeans a more competitive advantage with weeds.

If soybeans were grown in the field during the last 3 or 4 years and seed treatment is desired, it should be done several months before planting and the bacterial inoculant applied in dry form in the planter seed box at planting time.

If seed protectants are used, be sure to follow the manufacturer's instructions. For surest results before treating any seed lot, check the germination with and without the fungicide to determine the effect of seed treatment on each seed lot.

Inoculation

Increased yields of soybeans due to inoculation have been demonstrated where soybeans are grown on the land for the first time. This is not always true if soybeans occur in the rotation at least once every 3 to 4 years. It is, however, a good and inexpensive practice to inoculate the seed just prior to planting. A number of good commercial soybean inoculants are on the market. Following the directions given by the manufacturer will assure good nodulation of the crop.

Effective nodulation is a major economic factor in soybean production, since one pound of nodule nitrogen is equal to more than three pounds of fertilizer nitrogen A well-nodulated crop of soybeans will convert 60 to 65 pounds of atmospheric nitrogen into a form usable by the plants. This would then be the equivalent of 180 to 195 pounds per acre of nitrogen applied as fertilizer.

Recent research indicates that the application of improved strains of nodule-producing bacteria may be a simple and economical way of increasing yields.

Pre-inoculated soybean seed is marketed by many concerns. Since many types of material and many different methods have been used in pre-inoculating soybean seed, it is impossible to make any general statement concerning the effectiveness of this practice. Many different lots of pre-inoculated soybean seed have been evaluated during different time intervals following inoculation. Some lots remained effective for several weeks while others did not. A good general rule would be to inoculate according to the manufacturer's directions as close to planting time as is feasible.

Seedbed Preparation

An ideal seedbed consists of relatively firm soil with about two inches of loose soil on top.

The firm seedbed not only permits the movement of capillary water up through the soil, but also affords the germinating seed a firm base to support the pressure needed to break any soil surface crust. If crusting occurs before emergence, it may be necessary to break this crust with a rotary hoe, spiketooth harrow, or a cultipacker to aid emergence.

Fall plowing in preparation for planting soybeans is preferred on most heavy-textured soils. The freezing and thawing during winter results in an improved physical condition. Crop residues should be thoroughly incorporated into the soil and will thus have a greater opportunity for complete decomposition. Weed seeds that are near the surface of a fall-plowed field will germinate earlier than those moved to the surface by spring plowing and thus will afford a better opportunity for weed control. It is usually best to leave the land rough, if fall-plowed, in order to expose more soil surface and decrease soil erosion. Leaving a rough surface may increase water loss—also increase water intake. The balance will depend on the season.

Sands, silt loams, and soils subject to erosion should not be fall plowed. Spring plowing has the advantage of leaving a cover on the soil surface during the fall and winter. If spring-plowing is the method of preparing the land for soybean production, this should be done at least a month prior to planting. This will give the soil time to settle and produce a firm seedbed.

The actual plowing time is often determined by soil and moisture conditions and the amount of crop residue to be turned under. A heavy crop residue will generally require at least six to nine months to decompose fully.

Additional land preparation in the spring, regardless of when the soil was plowed, should consist of shallow cutting, stirring, and pulverizing the soil, and killing any existing vegetative growth. The disk harrow is probably the best implement for this purpose. A spike-tooth harrow and a cultipacker are excellent implements for preparation of the seedbed immediately preceding planting. The shorter the time between the last working and planting, the better chance the soybean plants have of controlling weeds through competition for sunlight, moisture, and plant nutrients.

Minimum tillage practices, such as those frequently used for corn, have shown little difference in seed yields when compared to "conventional" methods; however, minimum tillage practices will reduce production costs several dollars per acre.

Applying Lime and Fertilizer

The most desirable soil pH for soybeans is between 6.2 and 6.8. Whether or not they respond to direct application of fertilizer depends on the nutrient status of the soil and the soil reaction (acidity or alkalinity). Soybeans grown on soils low in phosphate and/or potassium generally respond to fertilizers containing these nutrients, providing the soil reaction has been properly adjusted by liming.

In order to determine the amount of available plant nutrients in the soil, it should be tested and the lime and fertilizer recommendations given by the Soil Testing Laboratory followed. In the absence of a soil test, an application of 200 pounds per acre of 0-20-20 or 5-20-20 fertilizer will usually be beneficial.

The amount of nutrients contained in a crop of soybeans yielding 40 bushel per acre is as follows: 200 pounds of N, 64 pounds of P_2O_5, and 96 pounds of K_2O. In normal harvesting of this crop, 150 pounds of N, 35 pounds of P_2O_5, and 55 pounds of K_2O are removed.

In well-nodulated soybeans, about 70 percent of the nitrogen is taken from the atmosphere. All other nutrients must be supplied by the soil or from applied fertilizer.

If it is desired to maintain the fertility level of the soil, it may be advisable, even though no direct yield response is expected, to fertilize the soybean crop at least with the minimum amounts of the phosphorous and potassium that the crop removes from the soil.

Soybeans are particularly susceptible to fertilizer (salt) injury; therefore, fertilizer contact with the seed should be avoided.

Fertilizer may be placed on the plow sole at the time of plowing; it may be broadcast and turned under; or it may be placed below and to one side of the seed at planting. The superiority of any of the above methods for direct fertilization of soybeans has not been definitely established.

If soil test recommendations indicate a need for lime, it should be applied before any fertilizer is applied.

Manganese deficiency can be detected by the yellowing of the leaf area between the veins while the veins remain green. The severity of this deficiency can be determined as the colors of areas vary from pale yellow to almost white. As soon as a deficiency is observed, corrective measures should be taken.

Where manganese deficiency is anticipated, spray the foliage when the plants are 4 to 6 inches high with 7 to 10 pounds of manganese sulphate in 10 to 20 gallons of water per acre, or apply 6 pounds per acre of elemental manganese mixed with row-applied fertilizer. The use of a row-applied complete fertilizer such as 5-20-20 will reduce the severity of manganese deficiency.

Planting

Date—For most of Ohio, the best time for planting soybeans is between May 15 and June 1. If planting is delayed beyond the first week in June, use early-maturing varieties. If it is desirable to plant before May 15, it is advisable to increase the rate of planting by about 25 percent. It may also be advisable to use seed protectants in order to obtain satisfactory stands. Although satisfactory yields may be obtained by early plantings, weeds are generally a more serious problem, and seed quality is reduced. Early maturity, if desired, can be obtained by planting early maturing varieties at an early planting date. Date of planting has little influence on date of maturity for full-season varieties. For

example, for every three days planting is delayed beyond May 15, the harvest date will be delayed only one day.

Rate—The number of seeds per pound among the recommended varieties may vary from 2100 to 3900. A 60-pound bushel of the small seeds (3900 per pound) would plant the same area as 110 pounds of the larger size (2100 per pound). Therefore, it is impractical to give the planting rate in pounds per acre.

The only sound recommendation that can be made in rate of planting is to specify the number of seeds per foot of row as outlined in table below.

Row Width	Seeds Planted per Foot of Row	Estimated Range in Pounds per Acre	Average* Pounds per Acre	Recommended Plants at Harvest	
				Per Foot	Per Acre
7"- 8" (drilled solid)	3-4	45-111	73	2-3	145,000
20"-21"	10-12	55-121	83	6-8	149,000
28"-30"	10-12	39-86	59	6-8	105,000
38"-40"	10-12	29-64	44	6-8	78,000

* Based on seed germinating 80% or better and on average sized seed (2800 seeds per pound)

The most satisfactory method for obtaining the recommended rate of seed drop is by "trial and error." Set the machine at a probable setting; then make an actual seed count by operating the machine on the driveway or solid ground over a measured distance. Adjustments can then be made to obtain the desired seed drop.

Planting at rates in excess of the recommended rate will:

(a) Waste seed
(b) Increase lodging
(c) Increase harvesting losses
(d) Increase incidence of disease
(e) Delay maturity

In soil that will crust badly, perhaps the seedling rate should be increased to have more plants to break the crust. When the emerged plants greatly exceed six to eight plants per foot of row, use of a spike-tooth harrow will help to thin the planting to a desired stand.

Method and Depth—Adequate moisture, proper temperature, and ample oxygen are necessary for a soybean seed to germinate and emerge rapidly. A soybean must contain about 50 percent moisture in comparison to corn requiring only 30 percent before germination starts. Good seed-soil contact is necessary to enable capillary water to move into the seed. This can be accomplished on a properly prepared seed bed if the seed is firmed into the soil at planting time.

Soybeans can be and are planted with corn planters, grain drills, and beet-bean planters. Regardless of equipment used, the seed should be firmed into the soil with some firming device such as seed wheels in corn planters or packing wheels behind grain drills.

The ideal date for planting soybeans depends partially on soil temperature and moisture. Shallow planting, from ½ to 1½ inches, will place the seed in a more favorable position in a "warming-up" soil than will deeper planting. The oxygen supply will also be more adequate at the shallower depths.

Deeper planting will generally delay emergence, and will allow weeds to get ahead of the soybean plants.

When certain herbicides are used to control weeds (see *Ohio Agronomy Guide*), it may be necessary to plant 2 to 2½ inches deep to avoid chemical injury to the germinating seed.

If the soil is very dry, it is advisable to wait until a rain before planting. Planting soybeans deep to reach moist soil will usually result in poor stands and low yields. Shallow planting under favorable soil conditions will produce rapid emergence allowing less time for crusts to form and weeds to start.

Row Spacing—Adequate weed control must be assumed in any discussion of width of row. With satisfactory weed control, yield increases are obtained as the rows become narrower even down to 7- or 8-inch rows or drilled solid.

The yield increase from narrow rows will be greater under the following conditions:

(a) Low level of soil fertility
(b) Delayed planting
(c) Early varieties
(d) Short or non-branching varieties
(e) Unfavorable growing conditions

Varieties recommended for production in Ohio will generally give a 10 to 15 percent increase in yield when rows are narrowed from 38 to 42 inches down to 24 to 28 inches. Narrowing rows below 24 inches will give further increase in yield, but this increase will not be as great as that mentioned above.

Effect of Row Width on Yield of Soybeans with Complete Weed Control

Variety	Planting Method	Columbus 5-year Average	Castalia 5-year Average
Monroe	Drilled solid	28.5	29.8
	28-in. row	26.0	24.8
	42-in. row	20.6	20.4
Harosoy	Drilled solid	33.3	31.7
	28-in. row	30 0	27.1
	42-in. row	25.4	23.0
Hawkeye	Drilled solid	30.7	
	28-in. row	29.2	
	42-in row	24.2	
Lincoln	Drilled solid	28 3	
	28-in. row	26.7	
	42-in. row	22.3	

Weed Control

Weed control in soybeans begins with good weed control in all other crops in the rotation. One rotational "weed" in soybeans is volunteer corn, since

large acreages of soybeans in Ohio are planted following corn. Effective control of this weed involves efficient corn harvest the preceding year.

Weeds will reduce soybean yields, delay combining, reduce harvesting efficiency, and increase the moisture content and inert material in the harvested crop. Production costs increase and net profits diminish in direct relation to the weed infestation of the land.

Early shading of the ground by soybean plants will reduce the weed problem. This is a good reason for carefully planting the correct amount of high quality seed.

Mechanical—Land that is prepared a month or more before soybean planting can usually be weeded one or more times with disc, spring-tooth, or spike-tooth harrows. This is very effective in overall weed control.

After soybeans have been planted, young weeds can usually be controlled with a rotary hoe or a spike-tooth harrow. These tools can be satisfactorily used from the time the plants are 2 to 3 inches tall until they are 6 to 8 inches tall, if this operation is performed in the afternoon of a bright, hot day when the soybean plants are slightly wilted.

Cultivation later in the season should be relatively shallow, to avoid excessive root pruning, and level, to avoid excessive ridging which interferes with efficient harvesting.

Chemical — Numerous effective pre-plant, pre-emergence, and post-emergence herbicides are now available for weed control in soybeans. The herbicide should be selected for the particular weed problem expected. The use of herbicides for efficient soybean production is discussed in detail in the current issue of the *Agronomy Guide.*

Cropping Sequences

Soybeans can be used advantageously in many crop rotations. Typical rotations in Ohio include soybeans following corn and a fall-seeded small grain crop following soybeans. A rotation of soybeans, wheat, and clover is quite common. Soybeans may be substituted for oats in a corn-oats-wheat-clover rotation or for the second crop of corn in a corn-corn-wheat-clover rotation.

A rotation in which soybeans do not appear more often than once every three or four years aids in controlling certain soybean diseases. Experiments using disease-resistant soybean varieties have sometimes indicated that soybean yields in a continuous cropping system are similar to yields produced in a two or three year rotation.

Continuous cropping with soybeans is generally not recommended. Continuous cropping may lead to the buildup of some disease to which the varieties grown have no resistance. Also, under continuous soybeans the fine-textured soils become compact with poor drainage and aeration. With only the soybean stems and roots returned to the soil, residues are not sufficient to maintain good soil tilth.

The more important advantages for growing soybeans in rotation include:

(a) Low labor requirement and less competition for labor at peak periods.

(b) Soybeans can be planted relatively late, if weather conditions dictate, with a reasonable assurance of respectable yields.

(c) As a cultivated crop, they aid in weed control.

(d) They have considerable drouth tolerance.

(e) Soybeans appear to perform better than many other crops following spring plowing.

Harvesting

Soybean harvesting losses frequently amount to 15 to 20 percent of the crop. It is possible to reduce these losses to 5 to 8 percent. Four beans per square foot left in the field means a loss of about 1 bushel per acre. It is important for every soybean producer to reduce soybean losses at combining time. If these losses exceed 8 percent, a careful check should be made to determine the cause and to make corrective adjustments.

According to the agricultural engineers, each of the four separate areas of the combine—cutting and feeding, threshing, separating, and cleaning—can be a source of loss. Of these four, the first—cutting and feeding—is usually the area of greatest loss.

A survey of soybean harvesting operations by Ohio agricultural engineers has shown losses as high as 33 percent. The average loss in 60 harvesting operations was about 15 percent. With proper adjustment and operation of the combine harvester, this loss could be reduced about 10 percent. This saving on the 1966 Ohio soybean crop would have been about 7,000,000 bushels.

For additional information on harvesting, see "Soybean Harvesting," Ohio Agricultural Experiment Station Bulletin 899, 1962 by B. J. Lamp, W. H. Johnson, K. A. Harkness, and P. S. Smith.

Seed Storage

Soybeans with a moisture content of 12 percent or less and low in percentage of splits and foreign materials can be stored for a year or longer without danger of deterioration. It is essential that soybeans be stored in tight, weatherproof bins with facilities for adequate aeration. Soybeans may be stored safely during cold weather for short periods of time with a moisture content as high as 14 percent with little loss in quality, but serious deterioration begins when the temperature increases.

Forced-air drying of soybeans may allow earlier combining than could be done otherwise. Drying soybeans with heated air has the advantage that it can be done at any time, regardless of weather conditions. Air temperature for drying soybeans should not exceed 110°F. for planting seed and 130° to 140°F. for market beans and should be held lower than this during the initial stages of drying if moisture content is high.

Soybean producers with available farm storage space at harvest time can usually expect the cost of storage to be about 2 cents per bushel per month. This does not include the added expense of filling the storage bins and removing the beans from storage at marketing time. In general, the lowest price for soybeans occurs from September to December, and the highest price in May, June, and July. For this reason, many farmers have found it profitable to store their beans until more favorable market prices occur. Almost half of current soybean production is exported. Export sales have a greater effect on the price of soybeans than does local demand.

Diseases

At one time, soybeans were considered in Ohio as a crop which was not attacked by diseases. This was essentially true for many years; however, now there are several diseases that can produce economic losses. The longer a crop is grown in a state or locality, or grown in an intensified area, the more prevalent diseases become.

At least 12 different diseases attacking soybeans have been observed in Ohio during annual disease surveys covering the western half of the state. Relatively few of these diseases have been considered of economic importance. Information is now being accumulated on the extent of the actual injury (yield reduction) resulting from the diseases.

Most soybean diseases reduce the efficiency of the plant rather than kill it; exceptions are Phythophthora root rot and other root diseases. One of the most important control measures for soybean diseases is the growing of resistant varieties.

Phythophthora root rot can attack a susceptible variety anytime from emergence to maturity. This disease of soybeans was first found and identified in Ohio. On heavy, poorly-drained soils, especially in northwestern Ohio, this disease has been devastating. The disease-producing organism can either stunt a plant and reduce the yield or kill it. The extent of loss depends on the prevalence of the disease as well as the severity.

Several soybean varieties on the recommended list are resistant to this disease. Soybean producers in Ohio need no longer fear the Phythophtora root rot disease, if they select varieties that are resistant. (See current issue of the *Ohio Agronomy Guide.*)

Soybean Diseases published as Agricultural Handbook No 302, July, 1966, by the Agricultural Research Service, U.S. Department of Agriculture, is an excellent publication and has colored pictures of most of the soybean diseases found in the U.S. Single copies may be obtained for 30 cents from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402.

Insect Pests

Insect injury to soybeans in Ohio has generally been of only minor importance for localized areas. Some of the most commonly observed insect pests include leafhoppers, grasshoppers, blister beetles, grape colaspies, and spider mites. Information on the damage done by these insects is limited, although the capacity to cause complete destruction of a crop must be assumed. Local county Extension agents or the State Cooperative Extension Service should be contacted before insecticides are applied.

Related Publications

1. *The Ohio Agronomy Guide*—Extension Bulletin 472. Ohio Cooperative Extension Service (current edition)
2. *Soybean Diseases*—Agricultural Handbook No. 302. 1966 Agricultural Research Service, U.S.D.A. (Supt. of Documents, U.S. Govt. Printing Office, Washington, D.C. 30¢)
3. *Soybean Harvesting*—Ohio Agr. Exp. Sta. Bulletin 899. 1962 by B. J. Lamp, W. H. Johnson, K. A. Harkness, and P. E. Smith.
4. *The Soybean,* Edited by A. G. Norman. 1963. Academic Press, New York (239 pages)
5. Performance Trials of Soybean Varieties in Ohio by P. E. Smith—O.A.R.D.C. (mimeo—current edition)

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